

CLAIMS:

What is claimed is:

1. A disposable downhole tool or a component thereof comprising an effective amount of biodegradable material such that the tool or the component desirably decomposes when exposed to a wellbore environment.
2. The disposable downhole tool or the component thereof of claim 1 wherein the biodegradable material comprises a degradable polymer.
3. The disposable downhole tool or the component thereof of claim 2 wherein the degradable polymer comprises an aliphatic polyester.
4. The disposable downhole tool or the component thereof of claim 3 wherein the aliphatic polyester comprises a polylactide.
5. The disposable downhole tool or the component thereof of claim 4 wherein the polylactide comprises poly(L-lactide), poly(D-lactide), poly(D,L-lactide), or combinations thereof.
6. The disposable downhole tool or the component thereof of claim 1 wherein the biodegradable material comprises one or more compounds selected from the group consisting of polysaccharides; chitin; chitosans; proteins; aliphatic polyesters; poly(lactides); poly(glycolides);

poly(ϵ -caprolactones); poly(hydroxybutyrates); poly(anhydrides); aliphatic polycarbonates; poly(orthoesters); poly(amino acids); poly(ethylene oxides); and polyphosphazenes.

7. The disposable downhole tool or the component thereof of claim 2 wherein the degradable polymer comprises polyanhydrides.

8. The disposable downhole tool or the component thereof of claim 1 wherein the biodegradable material comprises one or more compounds selected from the group consisting of poly(adipic anhydride), poly(suberic anhydride), poly(sebacic anhydride), poly(dodecanedioic anhydride), poly(maleic anhydride), and poly(benzoic anhydride).

9. The disposable downhole tool or the component thereof of claim 2 further comprising plasticizers.

10. The disposable downhole tool or the component thereof of claim 9 wherein the plasticizers comprise derivatives of oligomeric lactic acid.

11. The disposable downhole tool or the component thereof of claim 1 wherein the biodegradable material comprises poly(lactic acid).

12. The disposable downhole tool or the component thereof of claim 1 wherein the biodegradable material comprises poly(phenyllactide).

13. The disposable downhole tool or the component thereof of claim 2 further comprising a hydrated organic or inorganic solid compound.

14. The disposable downhole tool or the component thereof of claim 13 wherein the hydrated organic or inorganic solid compound comprises hydrates of organic acids or organic acid salts.

15. The disposable downhole tool or the component thereof of claim 13 wherein the hydrated organic or inorganic solid compound comprises one or more compounds selected from the group consisting of: sodium acetate trihydrate, L-tartaric acid disodium salt dihydrate, sodium citrate dihydrate, sodium tetraborate decahydrate, sodium hydrogen phosphate heptahydrate, sodium phosphate dodecahydrate, amylose, starch-based hydrophilic polymers, and cellulose-based hydrophilic polymers.

16. The disposable downhole tool or the component thereof of claim 1 wherein the biodegradable material comprises an aliphatic polyester and sodium acetate trihydrate.

17. The disposable downhole tool or the component thereof of claim 1 wherein the biodegradable material comprises a polyanhydride and sodium acetate trihydrate.

18. The biodegradable downhole tool or the component thereof of claim 1 wherein the biodegradable material is selected to achieve a desired decomposition rate when the tool is exposed to the wellbore environment.

19. The disposable downhole tool or the component thereof of claim 1 wherein the wellbore environment comprises an aqueous fluid.

20. The disposable downhole tool or the component thereof of claim 1 wherein the tool or the component is self-degradable.

21. The disposable downhole tool or the component thereof of claim 20 wherein the wellbore environment comprises a wellbore temperature of at least about 200 degrees Fahrenheit.

22. The disposable downhole tool or the component thereof of claim 1 wherein the decomposition is due to hydrolysis.

23. The disposable downhole tool or the component thereof of claim 1 further comprising an enclosure for storing a chemical solution that catalyzes decomposition.

24. The disposable downhole tool or the component thereof of claim 23 wherein the chemical solution comprises: a caustic fluid, an acidic fluid, an enzymatic fluid, an oxidizer fluid, a metal salt catalyst solution or a combination thereof.

25. The disposable downhole tool or the component thereof of claim 23 further comprising an activation mechanism for releasing the chemical solution from the enclosure.

26. The disposable downhole tool or the component thereof of claim 25 wherein the activation mechanism comprises a frangible enclosure body.
27. The disposable downhole tool or the component thereof of claim 25 wherein the activation mechanism is timer-controlled.
28. The disposable downhole tool or the component thereof of claim 25 wherein the activation mechanism is mechanically operated.
29. The disposable downhole tool or the component thereof of claim 25 wherein the activation mechanism is hydraulically operated.
30. The disposable downhole tool or the component thereof of claim 25 wherein the activation mechanism is electrically operated.
31. The disposable downhole tool or the component thereof of claim 25 wherein the activation mechanism is operated by a communication means.
32. The disposable tool or the component thereof of claim 1 wherein the decomposition comprises loss of structural integrity of the tool or the component.

33. The disposable tool or the component thereof of claim 1 wherein the decomposition comprises loss of functional integrity of the tool or the component.
34. The disposable tool or the component thereof of claim 1 wherein the tool or the component decomposes within about a predetermined amount of time.
35. The disposable downhole tool or the component thereof of claim 1 wherein the tool is a frac plug.
36. The disposable downhole tool or the component thereof of claim 1 wherein the tool is a bridge plug.
37. The disposable downhole tool or the component thereof of claim 1 wherein the tool is a packer.

38. A method for performing a downhole operation wherein a disposable downhole tool is installed within a wellbore comprising: desirably decomposing the tool or a component thereof *in situ* via exposure to the wellbore environment.

39. The method of claim 40 wherein the tool or the component thereof is fabricated from an effective amount of biodegradable material such that the tool or the component thereof desirably decomposes when exposed to the wellbore environment.

40. The method of claim 39 wherein the biodegradable material comprises: a degradable polymer.

41. The method of claim 39 further comprising selecting the biodegradable material to achieve a desired decomposition rate of the tool or the component thereof.

42. The method of claim 39 further comprising exposing the tool or the component thereof to an aqueous fluid.

43. The method of claim 42 wherein at least a portion of the aqueous fluid is released from a hydrated organic or inorganic solid compound within the tool when the compound is exposed to the wellbore environment.

44. The method of claim 43 wherein the wellbore environment comprises a wellbore temperature of at least about 200 degrees Fahrenheit.

45. The method of claim 42 wherein the tool or the component thereof is exposed to the aqueous fluid before the tool is installed in the wellbore.

46. The method of claim 42 wherein the tool or the component thereof is exposed to the aqueous while the tool is installed within the wellbore.

47. The method of claim 38 wherein the tool or the component thereof decomposes via hydrolysis.

48. The method of claim 38 wherein the decomposition comprises loss of structural integrity of the tool or the component thereof.

49. The method of claim 38 wherein the decomposition comprises loss of functional integrity of the tool or the component thereof.

50. The method of claim 38 wherein the tool or the component thereof decomposes within about a predetermined amount of time.

51. The method of claim 38 further comprising catalyzing decomposition of the tool or the component thereof by applying a chemical solution to the tool or the component thereof.

52. The method of claim 51 wherein the chemical solution comprises: a caustic fluid, an acidic fluid, an enzymatic fluid, an oxidizer fluid, a metal salt catalyst solution or a combination thereof.

53. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof before the downhole operation.

54. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof during the downhole operation.

55. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof after the downhole operation.

56. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof via a timer-controlled operation.

57. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof via a mechanical operation.

58. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof via a hydraulic operation.

59. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof via an electrical operation.

60. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof using a communication means.

61. The method of claim 51 wherein the chemical solution is applied to the tool or the component thereof by dispensing the chemical solution into the wellbore.

62. The method of claim 61 wherein the dispensing step comprises injecting the chemical solution into the wellbore.

63. The method of claim 61 wherein the dispensing step comprises:
lowering a frangible object containing the chemical solution into the wellbore; and
breaking the frangible object.

64. The method of claim 61 wherein the dispensing step comprises:
lowering a conduit into the wellbore; and
flowing the chemical solution through the conduit onto the tool.

65. The method of claim 51 further comprising:
moving a dart within the wellbore; and
engaging the dart with the tool to release the chemical solution.
66. The method of claim 65 wherein the dart contains the chemical solution.
67. The method of claim 65 wherein the tool or the component thereof contains the chemical solution.
68. The method of claim 65 wherein the moving step comprises pumping a fluid into the wellbore behind the dart.
69. The method of claim 65 wherein the moving step comprises allowing the dart to free fall by gravity.
70. The method of claim 38 wherein the tool comprises a frac plug, a bridge plug, or a packer.

71. A system for applying a chemical solution to a disposable downhole tool or the component thereof that desirably decomposes when exposed to a wellbore environment; wherein the chemical solution catalyzes decomposition of the tool or the component thereof.
72. The system of claim 71 further comprising an enclosure for containing the chemical solution.
73. The system of claim 72 wherein the enclosure is disposed on the tool.
74. The system of claim 72 further comprising an activation mechanism for releasing the chemical solution from the enclosure.
75. The system of claim 74 wherein the activation mechanism is a frangible enclosure body.
76. The system of claim 74 wherein the activation mechanism is timer-controlled.
77. The system of claim 74 wherein the activation mechanism is mechanically operated.
78. The system of claim 74 wherein the activation mechanism is hydraulically operated.
79. The system of claim 74 wherein the activation mechanism is electrically operated.

80. The system of claim 74 wherein the activation mechanism is operated by a communication means.
81. The system of claim 72 wherein the enclosure is broken to release the chemical solution.
82. The system of claim 81 wherein the enclosure is lowered to the tool on a slick line.
83. The system of claim 81 wherein the enclosure is dropped into the wellbore to engage the tool.
84. The system of claim 71 further comprising a conduit extending into the wellbore to apply the chemical solution onto the tool or the component thereof.
85. The system of claim 71 wherein the chemical solution comprises: a caustic fluid, an acidic fluid, an enzymatic fluid, an oxidizer fluid, a metal salt catalyst solution or a combination thereof.

86. A method of applying a chemical solution to a disposable downhole tool or the component thereof that desirably degrades when exposed to a wellbore environment; wherein the chemical solution catalyzes decomposition of the tool or the component thereof.

87. The method of claim 86 wherein the applying step comprises releasing the chemical solution from storage integral to the tool.

88. The method of claim 86 wherein the applying step comprises releasing the chemical solution from storage external to the tool.

89. The method of claim 86 wherein the applying step comprises dispensing the chemical solution into the wellbore.

90. The method of claim 86 wherein the degradation comprises loss of structural integrity of the tool or the component thereof.

91. The method of claim 86 wherein the degradation comprises loss of functional integrity of the tool or the component thereof.

92. The method of claim 86 wherein the tool or the component thereof degrades within about a predetermined amount of time.

93. The method of claim 86 wherein the applying step comprises a timer-controlled operation, a mechanical operation, a hydraulic operation, an electrical operation, an operation using a communication means, or a combination thereof.

94. The method of claim 86 wherein the applying step comprises breaking a container that stores the chemical solution.

95. A method for desirably decomposing a disposable downhole tool or the component thereof installed within a wellbore comprising:

releasing water from a compound within the tool or the component thereof due to exposure to heat in the wellbore; and

at least partially decomposing the tool or the component thereof by hydrolysis.

96. The method of claim 95 wherein the tool or the component thereof comprises an effective amount of biodegradable material such that the tool or the component thereof desirably decomposes when exposed to a wellbore environment.

97. The method of claim 96 wherein the biodegradable material comprises: a degradable polymer.

98. The method of claim 96 further comprising selecting the biodegradable material to achieve a desired decomposition rate of the tool or the component thereof.

99. The method of claim 95 wherein the decomposition comprises loss of structural integrity of the tool or the component thereof.

100. The method of claim 95 wherein the decomposition comprises loss of functional integrity of the tool or the component thereof.